

What is the relationship between the intake of animal protein products and prostate cancer?

Conclusion

Limited evidence shows that animal protein products are associated with prostate cancer incidence.

Grade: Limited

Overall strength of the available supporting evidence: Strong; Moderate; Limited; Expert Opinion Only; Grade not assignable For additional information regarding how to interpret grades [click here](#).

Evidence Summary Overview

The Committee reviewed six articles (Cross, 2005; Koutros, 2008; Michaud, 2001; Park, 2007; Rodriguez, 2006; Rohrmann, 2007) examining the relationship between animal protein products and incidence of prostate cancer published since 2000. All of the studies represented prospective cohorts from the US. Most studies reported no association between total, red, processed or white meat consumption, meat-cooking method and risk of total prostate cancer, incident cancer or advanced disease. However, in the Health Professionals Follow-Up Study (Michaud, 2001), positive associations between metastatic prostate cancer and red and processed meats were observed. Also, in the Cancer Prevention Study (Rodriguez, 2006), red meat (including processed red meat) and cooked processed meats were positively associated with prostate cancer in Black, but not White, men. Rohrmann and colleagues (2007) reported a positive association between the intake of processed meat and total and advanced prostate cancer, but did not observe relationships between cancer and other animal protein products.

Mixed results were observed regarding the level of doneness of meat. Well and very well done meat were associated with prostate cancer in the Prostate, Lung, and Colorectal and Ovarian (PLCO) Screening Trial (Cross, 2005) and the Agricultural Health Study (Koutros, 2008), but level of doneness was not related to cancer risk in the Multi-ethnic Cohort Study (Park, 2007) or Cancer Prevention Study (Rodriguez, 2006). Thus, cohort studies of animal protein products and prostate cancer since 2000 show little link between total meat intake and prostate cancer, although there may be a link between processed meat products, as well as well-done meat and prostate cancer.

Evidence summary paragraphs:

Cross et al, 2005 (positive quality) investigated whether meat intake or meat-related mutagens was associated with an increased risk for prostate cancer. Participants were 29,361 men (aged 55-74 years) in the Prostate, Lung, Colorectal and Ovarian (PLCO) Cancer Screening Trial (United States). All prostate cancers were pathologically confirmed. Dietary intake was assessed at baseline using a 137-item food frequency questionnaire (FFQ) and a detailed meat-cooking and doneness questionnaire; meat categories included in analyses were red meat, white meat, processed meat, barbecued meat, pan-fried meat and very well done meat. During follow-up, 1,338 prostate cancer cases were recorded; of these, 868 were incident cases and 520 were advanced cases. There was no association between total, red, processed or white meat consumption, meat-cooking method, or for meats cooked rare, medium or well-done and risk of total prostate cancer, incident cancer or advanced disease. For very well-done meat, there was an elevated risk for total prostate cancer

(RR=1.42; 95% CI: 1.05, 1.92; P for trend=0.02) and for incident disease (RR=1.69; 95% CI: 1.19, 2.40; P for trend=0.003), comparing men who consumed >10g per day to non-consumers. However, no association was evident for advanced disease (RR=1.23; 95% CI: 0.73, 2.06; P for trend=0.44). The authors concluded that the study does not support the hypothesis that red meat intake per se is a risk factor for prostate cancer; however, very well-done meat was positively associated with prostate cancer risk.

Koutros et al, 2008 (positive quality) investigated the association between meat types, cooking methods, doneness and mutagens on the risk of prostate cancer in the Agricultural Health Study (US). Participants were 23,080 male licensed pesticide applicators. Cancer diagnosis was obtained through linkage to cancer registries and to the state death registries and the National Death Index. Dietary intake was assessed with questionnaires that included questions about the frequency of intake of hamburgers, beef steaks, chicken, pork chops or ham steaks and bacon or sausage in the last 12 months. Additional questions were asked on “doneness” of hamburgers and beef steaks (rare, medium, well-done and very well-done) and bacon or sausage (just until done, well-done, charred or blackened) and cooking methods (pan-fried, broiled and grilled) for all meats. During 197,017 person-years of follow-up, 668 incident prostate cancer cases were identified (613 of these were diagnosed after the first year of follow-up and 140 were advanced cases). There was no association between total meat intake and prostate cancer risk among all cases, incident cases, or advanced cases when the highest quintile of intake was compared with the lowest (RR=1.04; 95% CI: 0.80, 1.35; P for trend=0.93, RR=1.06; 95% CI: 0.81, 1.38; P for trend=0.71 and RR=0.93; 95% CI: 0.51, 1.70; P for trend=0.80, respectively). Similarly, no association was observed for any of the following meat items: Total meat, red meat, chicken, bacon or sausage, beef steaks, pork chops or ham steaks and hamburgers. Increased intake of grilled meat, pan-fried meat or broiled meat was not associated with an increased risk of prostate cancer. Well- and very well-done total meat was significantly associated with prostate cancer in all cases (RR=1.22; 95% CI: 1.00, 1.49; P for trend=0.06), incident cases (RR=1.26; 95% CI: 1.02, 1.54; P for trend=0.03), and advanced cases (RR=1.97; 95% CI: 1.26, 3.08; P for trend=0.004) when the highest tertile was compared with the lowest. The authors concluded that well- and very well-done meat was associated with an increased risk for prostate cancer in this cohort.

Michaud et al, 2001 (positive quality) used prospective cohort data from the Health Professionals Follow-up Study to examine whether specific types of animal products or different components of animal products (e.g., calcium and types of fats) are associated with prostate cancer risk in 47,780 men from the US (aged 40-75 years). Prostate cancer status was self-reported on biennial questionnaires with medical record confirmation. Dietary intake over the previous year was estimated in 1986, 1990 and 1994 using a 131-item self-administered, mailed FFQ. Between 1986 and 1996, 1897 total cases of prostate cancer (excluding stage A1) were identified; of these, 536 were advanced and 249 were metastatic cancers. Intakes of total and red meat were not associated with risk of total or advanced prostate cancer. An elevated risk of metastatic prostate cancer was observed with intake of red meat, which was slightly attenuated after controlling for saturated fat and alpha-linoleic fatty acids (RR=1.5, 95% CI: 0.88, 2.5; P for trend=0.20). Processed meats, bacon and beef, pork or lamb as a main dish each contributed to an elevated risk of metastatic prostate cancer. Men who consumed processed meats twice or more per week had a relative risk of 1.4 (95% CI: 0.94, 2.1; P for trend=0.08), compared to men who did not eat processed meat, after controlling for saturated fat and alpha-linolenic acid. Similar risks were observed among men consuming bacon twice or more a week (P for trend=0.08). An elevated risk of metastatic prostate cancer was also observed among high consumers of beef, pork or lamb (five or more per week), eaten as a main dish (RR=1.4, 95% CI: 0.72, 2.5; P for trend=0.24). Intakes of hamburgers, hot dogs and chicken (with or without skin) were not associated with increased risk of metastatic prostate cancer. There was a

two-fold increase in the risk of metastatic prostate cancer when those who had high intakes of both red meat and dairy products were compared to those with low intakes of both products, but this association was attenuated after controlling for potential confounders. The authors concluded that intakes of red meat appear to be related to increased risk of metastatic prostate cancer.



Park et al, 2007 (positive quality) examined the association between prostate cancer risk and the intake of fat, cholesterol, meat, fish and fats from meat in the Multiethnic Cohort Study (N=82,483 men, ≥ 45 years) in the US. Incident cases of prostate cancer were identified by linkage to three population-based cancer registries. Dietary intake was assessed using self-administered FFQ with 180 items at baseline. Intake of meat was calculated as the sum of grams from single food items of meat and relevant portions of mixed dishes, estimated from recipes. Total meat, poultry and processed meat as well as individual meat groups (beef, pork, red meat, poultry and processed meat) were examined. During the follow-up period of eight years, a total of 4,404 incident cases, including 1,278 non-localized or high-grade cancer cases, were identified. Intakes of total, red, and processed meat and individual meat items did not show a statistically significant association with risk. No association between meat preparation and prostate cancer risk was observed RR of well-done vs. rare or medium=1.10; 95% CI: 0.91, 1.33. The authors concluded that intake of different types of fat and meat showed no strong association with overall prostate cancer risk.





Rodriguez et al, 2006 (positive quality) examined the association between unprocessed red meat, processed meats and poultry intake among White and Black men in relation to prostate cancer incidence in the Cancer Prevention Study II Nutrition Cohort (N=692 Black and 64,856 White men) in the US. Cancer incidence was initially identified through self-report on follow-up questionnaires and subsequently verified by medical records or by linkage to state cancer registries and the National Death Index. Dietary intake over the past year was assessed at baseline using a 68-item modified Block FFQ. The analyses considered intake of total red meat, unprocessed red meat, processed meat (which was further categorized as cooked processed or lunch meats) and poultry, computed by summing across all items that contribute to each group. "Doneness" was also considered. From 1992 to 2001, 85 and 5,028 cases of incident prostate cancer were observed among Black and White men, respectively. Total red meat (processed plus unprocessed red meat) consumption was associated with higher incidence of prostate cancer among Black men (rate ratio [RR]=2.0; 95% CI: 1.0, 4.2, for highest vs. lowest quartiles; P for trend=0.05). However, among White men, no association was seen between total red meat consumption and either the overall incidence of prostate cancer (RR=1.0; 95% CI: 0.9, 1.0) or metastatic (RR=0.8; 95% CI: 0.5, 1.3) prostate cancer. Black men in the highest category of processed meat consumption had higher risk of total incident prostate cancer than those in the lowest quartile (RR=2.4; 95% CI: 1.2, 4.9; P for trend=0.008). This increased risk of prostate cancer among Black men was associated solely with consumption of cooked processed meat (bacon, hot dogs and sausages; RR=2.7; 95% CI: 1.3, 5.3 for the highest vs. lowest quartiles; P for trend=0.008) and not with consumption of lunch meats. The risk of metastatic prostate cancer was associated with consumption of cooked processed meats (P for trend=0.04) among White men in analyses adjusted only for age, but this association was attenuated by further adjustment. No other measure of meat intake was associated with risk of prostate cancer. Reported preference for red meat doneness was not associated with risk of prostate cancer among White or Black men. The authors concluded that that high consumption of cooked processed meats may contribute to prostate cancer risk among Black men in the US.

Rohrmann et al, 2007 (positive quality) conducted a prospective cohort study in men to evaluate the association of the intake of total meat, specific types of meat, dairy foods and others rich in calcium and total dietary supplemental calcium intake with prostate cancer. Subjects were men (N=3,892; 53.8 years of age; BMI of 26.5kg/m²) who were participating in the CLUE II study based in Washington County, MD, which began in 1989. Meat intake was assessed at baseline using

an abbreviated version of the Block FFQ that was administered by mail to assess the frequency and portion size of consumption of 60 food items. Items included in analyses were total meat, beef, processed meat, red meat and poultry. Prostate cancer diagnosis was assessed using the Washington County Cancer Registry and Maryland Cancer Registry in October 2004. From 1989 through October 2004, 199 incident prostate cancer cases were ascertained. Results showed no significant (NS) relationships between total meat, red meat or poultry intake with total, low-stage or high-stage prostate cancer. Processed meat consumption was associated with a non-statistically significant higher risk of total (5+ vs. less than one serving per week: HR=1.53, 95% CI: 0.98, 2.39; P for trend=0.20) and advanced (HR=2.24; 95% CI: 0.90, 5.59; P for trend=0.22) prostate cancer. The authors concluded that consumption of processed meat, but not total meat or red meat, was associated with a possible increased risk of total prostate cancer in this prospective study.

 [View table in new window](#)

Author, Year, Study Design, Class, Rating	Study Name/Location	Total Meat Association (Pos, Neg, None)	Read Meat Association (Pos, Neg, None)	Processed Meat Association (Pos, Neg, None)	Poultry Association (Pos, Neg, None)
Cross et al 2005; Cancer Res Study Design: Prospective Cohort Study Class: B Rating: 	Prostate, Lung, Colorectal and Ovarian (PLCO) Screening Trial. Location: US.	Ø Total, incident or advanced. Very well-done meat: (+) Total and incident, Ø Advanced.	Ø Total, incident or advanced.	Ø Total, incident or advanced.	White meat: Ø Total, incident or advanced.
Koutros S et al 2008 Study Design: Prospective cohort design Class: B Rating: 	Agricultural Health Study. Location: US.	Ø Total, incident or advanced. Well- and very well-done meat: (+) Total, incident, and advanced.	Ø Total, incident or advanced.	Bacon/sausage: Ø Total, incident or advanced.	Chicken: Ø Total, incident or advanced.


<p>Michaud DS, Augustsson K et al, 2001</p> <p>Study Design: Prospective Cohort Study</p> <p>Class: B</p> <p>Rating: </p>	<p>Health Professionals Follow Up Study.</p> <p>Location: US.</p>	<p>Ø Total or advanced.</p>	<p>Ø Total or advanced.</p> <p>(+) Metastatic.</p>	<p>(+) Metastatic.</p>	<p>Chicken: Ø Metastatic.</p>
<p>Park et al 2007; Int J Cancer</p> <p>Study Design: Prospective cohort design</p> <p>Class: B</p> <p>Rating: </p>	<p>Multiethnic Cohort Study.</p> <p>Location: US.</p>	<p>Ø; Doneness: Ø.</p>	<p>Not examined.</p>	<p>Ø.</p>	<p>Poultry: Ø.</p>
<p>Rodriguez et al 2006</p> <p>Study Design: Prospective cohort study</p> <p>Class: B</p> <p>Rating: </p>	<p>Cancer Prevention Study II Nutrition Cohort.</p> <p>Location: US.</p>	<p>Red plus processed red meat: + Black men, Ø White men.</p> <p>Doneness: Ø.</p>	<p>Not examined.</p>	<p>Cooked processed meat: (+) Black men only.</p> <p>Lunchmeats: Ø.</p>	<p>Not examined.</p>
<p>Rohrmann S, Platz EA et al, 2007</p> <p>Study Design: Prospective cohort study</p> <p>Class: B</p> <p>Rating: </p>	<p>CLUE II.</p> <p>Location: US.</p>	<p>Ø Total, low-, or high-stage.</p>	<p>Ø Total, low-, or high-stage.</p>	<p>(+) Total and advanced.</p>	<p>Poultry: Ø Total, low-, or high-stage.</p>


Research Design and Implementation Rating Summary

For a summary of the Research Design and Implementation Rating results, [click here](#).


Worksheets


 [Cross AJ, Peters U, Kirsh VA, Andriole GL, Reding D, Hayes RB, Sinha R. A prospective study of meat and meat mutagens and prostate cancer risk. *Cancer Res* 2005; 65: 11779-11784.](#)

 [Koutros S, Cross AJ, Sandler DP, Hoppin JA, Ma X, Zheng T, Alavanja MCR, Sinha R. Meat and meat mutagens and risk of prostate cancer in the agricultural health study. *Cancer Epidemiol Biomarkers Prev* 2008;17:80-87.](#)

 [Michaud DS, Augustsson K, Rimm EB, Stampfer MJ, Willet WC, Giovannucci E. A prospective study on intake of animal products and risk of prostate cancer. *Cancer Causes Control*. 2001 Aug; 12 \(6\): 557-567.](#)

 [Park SY, Murphy SP, Wilkens LR, Henderson BE, Kolonel LN. Fat and meat intake and prostate cancer risk: The Multiethnic Cohort Study. *Int J Cancer* 2007; 121:1339-1345.](#)

 [Rodriguez C, McCullough ML, Mondul AM, Jacobs EJ, Chao A, Patel AV, Thun MJ, Calle EE. Meat consumption among black and white men and risk of prostate cancer in the Cancer Prevention Study II Nutrition Cohort. *Cancer Epidemiol Biomarkers Prev* 2006; 15\(2\):211-216.](#)

 [Rohrmann S, Platz EA, Kavanaugh CJ, Thuita L, Hoffman SC, Helzlsouer KJ. Meat and dairy consumption and subsequent risk of prostate cancer in a US cohort study. *Cancer Causes Control*. 2007 Feb; 18 \(1\): 41-50.](#)